PERIODICAL PLASMA STRUCTURES CONTROLLED BY EXTERNAL MAGNETIC FIELD

I. Schweigert[1,2], M. Keidar[1]

[1]*George Washington University, Washington D.C. 20052, USA*
[2]*Khristianovich Institute of Theoretical and Applied Mechanics, Novosibirsk, Russia*

The characteristics of 2D periodical structures in propulsion type magnetized plasma are studied in kinetic PIC MCC simulations.With increasing an angle of magnetic field the ridges (maxima) of electron and ion densities form in the plasma volume in cylindrical chamber. These ridges are shifted relative each other that results in the formation of 2D double-layers structure. Depending on Larmor radius and Debye length up to nineteen potential steps appear across the oblique magnetic field.

Recently some methods to control the Hall effect thruster characteristics with applying the oblique magnetic field B with respect to the channel walls is widely discussed (see [1]). Nevertheless with increasing the magnetic field angle α_B, discharge plasma properties can essentially change. For example, a several magnetized double-layers were observed in a laboratory experiment for this type of plasma [2].In this work [3],in kinetic simulations we consider the DC discharge plasma in the external oblique magnetic field at P=0.0001 Torr. Our purpose is to study the plasma structure modification with changing the electron temperature, magnetic field strength and obliqueness. In simulations, the plasma is embedded in a cylindrical chamber with r=4 cm and H=10 cm. All walls are grounded and the cathode is biased with -90 V, B=25-100 G and α_B =0-77^o. To describe the plasma in electro-magnetic field we solve Boltzmann equations for the distribution functions for electrons and ions with particle-in cell Monte Carlo collision method and Poisson equation for the electrical potential.The periodical structure with ridges of ion and electron densities was found for larger α_B. The electron and ion ridges are shifted with respect to each other and double–layer structure appears across B-field and along the potential rise. The double-layers structure forms due to a distortion of local quasineutrality in the presence of oblique magnetic field. The ion current to the wall considerably increases and has a peaked profile in the case of largeα_B. This effect can lead to an additional local erosion of wall material.The current flow channels are associated with ridges of electron and ion densities and aligned with B-vector.The characteristics of plasma structure such as the number of peaks, gap between them, their broadening depend on the Larmor radius, Debye length and the size of quasineutral plasma.

REFERENCES

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